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CRC Press

Boca Raton London New York Washington, D.C.

Library of Congress Cataloging-in-Publication Data

Boldea, I.

Induction Machines Handbook / Ion Boldea, Syed A. Nasar

p. cm. -- (Electric power engineering series)

Includes bibliographical references and index.

ISBN 0-8493-0004-5 (alk. paper)

1. Electric machinery, Induction--Handbooks, manuals, etc. I. Nasar, S.A. II Title.

III. Series.

TK2711.B65 2001

621.31'042--dc21

2001043027

CIP

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International Standard Book Number 0-8493-0004-5

Library of Congress Card Number 2001043027

Printed in the United States of America 1 2 3 4 5 6 7 8 9 0

Printed on acid-free paper

*A humble tribute to Nikola Tesla and
Galileo Ferraris*

PREFACE

The well being of the environmentally-conscious contemporary world is strongly dependent on its efficient production and use of electric energy.

Electric energy is produced with synchronous generators, but for the flexible, distributed, power systems of the near future, the induction machine as an electric generator/motor at variable speeds, is gaining more and more ground.

Pump storage hydroelectric plants already use doubly fed induction machines up to 300MW/unit with the power electronic converter on the rotor side.

On the other hand, the induction motor is the **work horse** of industry due to its ruggedness, low cost, and good performance, when fed from the standard a.c. power grid.

The developments in power electronics and digital control have triggered the widespread use of induction motors for variable speed drives in most industries.

We can safely say that in the last decade the variable speed induction motor has already become the **race horse** of industry.

While in constant speed applications better efficiency and lower costs are the main challenges, in variable speed drives, motion control response quickness, robustness, and precision for ever wider speed and power ranges are the new-added performance indexes.

The recent development of super-high-speed variable drives for speeds up to 60,000 rpm and power in the tens of kW also pose extraordinary technological challenges.

In terms of research and development, new analysis tools such as finite element field methods, design optimization methods, advanced nonlinear circuit models for transients, vector and direct torque control, and wide frequency spectrum operation with power electronics have been extensively used in connection with induction machines in the last 20 years.

There is a dynamic worldwide market for induction machines for constant and variable speed applications; however, an up-to-date comprehensive and coherent treatise in English, dedicated to the induction machine (three phase and single phase)-embracing the wide variety of complex issues of analysis and synthesis (design)-is virtually nonexistent as of this writing. The chapters on IMs in Electric Motor handbooks contain interesting information but lack coherency and completeness.

This book is a daring attempt to build on the now classical books of R. Richter, P. Alger, Heller & Hamata, C. Veinott, and P. Cochran, on induction machines.

It treats in 28 chapters a wide spectrum of issues such as induction machine applications, principles and topologies, materials, windings, electric circuit parameter computation, equivalent circuits (standard and new) and steady state performance, starting and speed control methods, flux harmonics and parasitic torques, skin and saturation effects, fundamental and additional (space and time harmonics) losses, thermal modeling and cooling, transients, specifications and

design principles, design below 100 kW, design above 100 kW, design for variable speed, design optimization, three-phase induction generators, linear induction motors, super-high-frequency modelling and behaviour of IMs, testing of three-phase induction machines and single-phase IMs (basics, steady state, transients, generators, design, testing).

Numerical examples, design case studies, and transient behavior waveforms are presented throughout the chapters to make the book self sufficient and easy to use by either young or experienced readers from academia and industry.

It is aimed to be usable and inspiring at the same time it treats both standard and new subjects in induction machines. The rather detailed table of contents is self explanatory in this regard.

Input from readers is most welcome.

The authors

June 2001
Timisoara, RO-1900
Lexington, KY-40506

CONTENTS

Preface

Contents

- 1 Induction Machines: an Introduction
 - 1.1 Electric Energy and Induction Motors
 - 1.2 A Historical Touch
 - 1.3 Induction Machines in Applications
 - 1.4 Conclusion
 - 1.5 References
- 2 Construction Aspects and Operation Principles
 - 2.1 Construction Aspects of Rotary IMs
 - 2.1.1 The Magnetic Cores
 - 2.1.2 Slot Geometry
 - 2.1.3 IM Windings
 - 2.1.4 Cage Rotor Windings
 - 2.2 Construction Aspects of Linear Induction Motors
 - 2.3 Operation Principles of IMs
 - 2.4 Summary
 - 2.5 References
- 3 Magnetic, Electric, and Insulation Materials for IM
 - 3.1 Introduction
 - 3.2 Soft Magnetic Materials
 - 3.3 Core (Magnetic) Losses
 - 3.4 Electrical Conductors
 - 3.5 Insulation Materials
 - 3.5.1 Random-Wound IM Insulation
 - 3.5.2 Form-Wound Windings
 - 3.6 Summary
 - 3.7 References
- 4 Induction Machine Windings And Their M.M.Fs
 - 4.1 Introduction
 - 4.2 The Ideal Traveling M.M.F. of A.C. Windings
 - 4.3 A Primitive Single-Layer Winding
 - 4.4 A Primitive Two-Layer Chorded Winding
 - 4.5 The mmf Harmonics For Integer Q
 - 4.6 Rules For Designing Practical A.C. Windings
 - 4.7 Basic Fractional Q Three-Phase A.C. Windings
 - 4.8 Basic Pole-Changing Three-Phase A.C. Windings
 - 4.9 Two-Phase A.C. Windings
 - 4.10 Pole-Changing With Single-Phase Supply Induction Motors
 - 4.11 Special Topics On A.C. Windings
 - 4.12 The mmf of Rotor Windings
 - 4.13 The “Skewing” mmf Concept

- 4.14 [Summary](#)
- 4.15 [References](#)
- 5 [The Magnetization Curve and Inductance](#)
 - 5.1 [Introduction](#)
 - 5.2 [Equivalent Airgap to Account for Slotting](#)
 - 5.3 [Effective Stack Length](#)
 - 5.4 [The Basic Magnetisation Curve](#)
 - 5.4.1 [The Magnetization Curve Via The Basic Magnetic Circuit](#)
 - 5.4.2 [Teeth Defluxing By Slots](#)
 - 5.4.3 [Third Harmonic Flux Modulation Due to Saturation](#)
 - 5.4.4 [The Analytical Iterative Model \(AIM\)](#)
 - 5.5 [The Emf in An A.C. Winding](#)
 - 5.6 [The Magnetization Inductance](#)
 - 5.7 [Summary](#)
 - 5.8 [References](#)
- 6 [Leakage Inductances and Resistances](#)
 - 6.1 [Leakage Fields](#)
 - 6.2 [Differential Leakage Inductances](#)
 - 6.3 [Rectangular Slot Leakage Inductance/Single Layer](#)
 - 6.4 [Rectangular Slot Leakage Inductance/Two Layers](#)
 - 6.5 [Rounded Shape Slot Leakage Inductance/Two Layers](#)
 - 6.6 [Zig-Zag Airgap Leakage Inductances](#)
 - 6.7 [End-Connection Leakage Inductance](#)
 - 6.8 [Skewing Leakage Inductance](#)
 - 6.9 [Rotor Bar and End Ring Equivalent Leakage Inductance](#)
 - 6.10 [Basic Phase Resistance](#)
 - 6.11 [The Cage Rotor Resistance](#)
 - 6.12 [Simplified Leakage Saturation Corrections](#)
 - 6.13 [Reducing the Rotor to Stator](#)
 - 6.14 [Summary](#)
 - 6.15 [References](#)
- 7 [Steady State Equivalent Circuit and Performance](#)
 - 7.1 [Basic Steady-State Equivalent Circuit](#)
 - 7.2 [Classification of Operation Modes](#)
 - 7.3 [Ideal No-Load Operation](#)
 - 7.4 [Short-Circuit \(Zero Speed\) Operation](#)
 - 7.5 [No-Load Motor Operation](#)
 - 7.6. [The Motor Mode of Operation](#)
 - 7.7 [Generating to Power Grid](#)
 - 7.8 [Autonomous Induction Generator Mode](#)
 - 7.9 [The Electromagnetic Torque](#)
 - 7.10 [Efficiency and Power Factor](#)
 - 7.11 [Phasor Diagrams: Standard and New](#)
 - 7.12 [Alternative Equivalent Circuits](#)
 - 7.13 [Unbalanced Supply Voltages](#)
 - 7.14 [One Stator Phase is Open](#)

- 7.15 Unbalanced Rotor Windings
- 7.16 One Rotor Phase is Open
- 7.17 When Voltage Varies Around Rated Value
- 7.18 Summary
- 7.19 References
- 8 Starting and Speed Control Methods
 - 8.1 Starting of Cage-Rotor Induction Motors
 - 8.1.1 Direct Starting
 - 8.1.2 Autotransformer Starting
 - 8.1.3 Wye-Delta Starting
 - 8.1.4 Softstarting
 - 8.2 Starting of Wound-Rotor Induction Motors
 - 8.3 Speed Control Methods for Cage-Rotor Induction Motors
 - 8.3.1 The Voltage Reduction Method
 - 8.3.2 The Pole-Changing Method
 - 8.4 Variable Frequency Methods
 - 8.4.1 V/F Scalar Control Characteristics
 - 8.4.2 Rotor Flux Vector Control
 - 8.5 Speed Control Methods for Wound Rotor Ims
 - 8.5.1 Additional Voltage to The Rotor (The Doubly-Fed Machine)
 - 8.6 Summary
 - 8.7 References
- 9 Skin and On – Load Saturation Effects
 - 9.1 Introduction
 - 9.2 The Skin Effect
 - 9.2.1 Single Conductor in Rectangular Slot
 - 9.2.2 Multiple Conductors in Rectangular Slots: Series Connection
 - 9.2.3 Multiple Conductors in Slot: Parallel Connection
 - 9.2.4 The Skin Effect in the End Turns
 - 9.3 Skin Effects By The Multilayer Approach
 - 9.4 Skin Effect in the End Rings via The Multilayer Approach
 - 9.5 The Double Cage Behaves Like a Deep Bar Cage
 - 9.6 Leakage Flux Path Saturation—A Simplified Approach
 - 9.7 Leakage Saturation And Skin Effects—A Comprehensive Analytical Approach
 - 9.7.1 The Skewing Mmf
 - 9.7.2 Flux in The Cross Section Marked By AB (Figure 9.25)
 - 9.7.3 The Stator Tooth Top Saturates First
 - 9.7.4 Unsaturated Rotor Tooth Top
 - 9.7.5. Saturated Rotor Tooth Tip
 - 9.7.6 The Case of Closed Rotor Slots
 - 9.7.7 The Algorithm
 - 9.8 The FEM Approach
 - 9.9 Performance of Induction Motors With Skin Effect
 - 9.10 Summary

- 9.11 References
- 10 Airgap Field Space Harmonics, Parasitic Torques, Radial Forces, and Noise
 - 10.1 Stator mmf Produced Airgap Flux Harmonics
 - 10.2 Airgap Field of A Squirrel Cage Winding
 - 10.3 Airgap Conductance Harmonics
 - 10.4 Leakage Saturation Influence on Airgap Conductance
 - 10.5 Main Flux Saturation Influence on Airgap Conductance
 - 10.6 The Harmonics-Rich Airgap Flux Density
 - 10.7 The Eccentricity Influence on Airgap Magnetic Conductance
 - 10.8 Interactions of Mmf (or Step) Harmonics and Airgap Magnetic Conductance Harmonics
 - 10.9 Parasitic Torques
 - 10.9.1 When Do Asynchronous Parasitic Torques Occur?
 - 10.9.2 Synchronous Parasitic Torques
 - 10.9.3 Leakage Saturation Influence on Synchronous Torques
 - 10.9.4 The Secondary Armature Reaction
 - 10.9.5 Notable Differences Between Theoretical and Experimental Torque/Speed Curves
 - 10.9.6 A Case Study: $N_s/N_r = 36/28$, $2p_l = 4$, $Y/\tau = 1$ and $7/9$; $M = 3$ [7]
 - 10.9.7 Evaluation of Parasitic Torques By Tests (After [1])
 - 10.10 Radial Forces and Electromagnetic Noise
 - 10.10.1 Constant Airgap (No Slotting, No Eccentricity)
 - 10.10.2 Influence of Stator/Rotor Slot Openings, Airgap Deflection and Saturation
 - 10.10.3 Influence of Rotor Eccentricity On Noise
 - 10.10.4 Parallel Stator Windings
 - 10.10.5 Slip-Ring Induction Motors
 - 10.10.6 Mechanical Resonance Stator Frequencies
 - 10.11 Summary
 - 10.12 References
- 11 Losses in Induction Machines
 - 11.1 Loss Classifications
 - 11.2 Fundamental Electromagnetic Losses
 - 11.3 No-Load Space Harmonics (Stray No-Load) Losses in Nonskewed IMs
 - 11.3.1 No-Load Surface Core Losses
 - 11.3.2 No-Load Tooth Flux Pulsation Losses
 - 11.3.3 No-Load Tooth Flux Pulsation Cage Losses
 - 11.4 Load Space Harmonics (Stray Load) Losses in Nonskewed IMs
 - 11.5 Flux Pulsation (Stray) Losses in Skewed Insulated Bars
 - 11.6 Interbar Current Losses in Noninsulated Skewed Rotor Cages
 - 11.7 No-Load Rotor Skewed Noninsulated Cage Losses
 - 11.8 Load Rotor Skewed Noninsulated Cage Losses
 - 11.9 Rules to Reduce Full Load Stray (Space Harmonics) Losses

- 11.10 High Frequency Time Harmonics Losses
 - 11.10.1 Conductor Losses
 - 11.10.2 Core Losses
 - 11.10.3 Total Time Harmonics Losses
- 11.11 Computation of Time Harmonics Conductor Losses
- 11.12 Time Harmonics Interbar Rotor Current Losses
- 11.13 Computation of Time Harmonics Core Losses
 - 11.13.1 Slot Wall Core Losses
 - 11.13.2 Zig-Zag Rotor Surface Losses
- 11.14 Loss Computation by Fem
- 11.15 Summary
- 11.16 References
- 12 Thermal Modeling and Cooling
 - 12.1 Introduction
 - 12.2 Some Air Cooling Methods for IMs
 - 12.3 Conduction Heat Transfer
 - 12.4 Convection Heat Transfer
 - 12.5 Heat Transfer by Radiation
 - 12.6 Heat Transport (Thermal Transients) in a Homogenous Body
 - 12.7 Induction Motor Thermal Transients at Stall
 - 12.8 Intermittent Operation
 - 12.9 Temperature Rise (T_{on}) and Fall (T_{off}) Times
 - 12.9 More Realistic Thermal Equivalent Circuits for IMs
 - 12.10 A Detailed Thermal Equivalent Circuit for Transients
 - 12.11 Thermal Equivalent Circuit Identification
 - 12.12 Thermal Analysis Through FEM
 - 12.13 Summary
 - 12.14 References
- 13 Induction Machine Transients
 - 13.1 Introduction
 - 13.2 The Phase Coordinate Model
 - 13.3 The Complex Variable Model
 - 13.4 Steady-State by The Complex Variable Model
 - 13.5 Equivalent Circuits for Drives
 - 13.6 Electrical Transients with Flux Linkages as Variables
 - 13.7 Including Magnetic Saturation in The Space Phasor Model
 - 13.8 Saturation and Core Loss Inclusion into The State-Space Model
 - 13.9 Reduced Order Models
 - 13.9.1 Neglecting Stator Transients
 - 13.9.2 Considering Leakage Saturation
 - 13.9.3 Large Machines: Torsional Torque
 - 13.10 The Sudden Short-Circuit at Terminals
 - 13.11 Most Severe Transients (so far)
 - 13.12 The abc-dq Model for PWM Inverter Fed IMs
 - 13.13 First Order Models Of IMs for Steady-State Stability in Power Systems

- 13.14 Multimachine Transients
- 13.15 Subsynchronous Resonance (SSR)
- 13.16 The M/N, Actual Winding Modeling for Transients
- 13.17 Summary
- 13.18 References
- 14 Motor Specifications and Design Principles
 - 14.1 Introduction
 - 14.2 Typical Load Shaft Torque/Speed Envelopes
 - 14.3 Derating
 - 14.4 Voltage and Frequency Variation
 - 14.5 Induction Motor Specifications for Constant V/f
 - 14.6 Matching IMs to Variable Speed/Torque Loads
 - 14.7 Design Factors
 - 14.8 Design Features
 - 14.9 The Output Coefficient Design Concept
 - 14.10 The Rotor Tangential Stress Design Concept
 - 14.11 Summary
 - 14.12 References
- 15 IM Design Below 100 kW and Constant V and f
 - 15.1 Introduction
 - 15.2 Design Specifications by Example
 - 15.3 The Algorithm
 - 15.4 Main Dimensions of Stator Core
 - 15.5 The Stator Winding
 - 15.6 Stator Slot Sizing
 - 15.7 Rotor Slots
 - 15.8 The Magnetization Current
 - 15.9 Resistances and Inductances
 - 15.10. Losses and Efficiency
 - 15.11 Operation Characteristics
 - 15.12 Temperature Rise
 - 15.13 Summary
 - 15.14 References
- 16 Induction Motor Design Above 100kW and Constant V/f
 - 16.1 Introduction
 - 16.2 High Voltage Stator Design
 - 16.3 Low Voltage Stator Design
 - 16.4 Deep Bar Cage Rotor Design
 - 16.5 Double Cage Rotor Design
 - 16.6 Wound Rotor Design
 - 16.7 IM with Wound Rotor-Performance Computation
 - 16.8 Summary
 - 16.9 References
- 17 Induction Machine Design for Variable Speed
 - 17.1 Introduction

- 17.2 Power and Voltage Derating
- 17.3 Reducing the Skin Effect in Windings
- 17.4 Torque Pulsations Reduction
- 17.5 Increasing Efficiency
- 17.6 Increasing the Breakdown Torque
- 17.7 Wide Constant Power Speed Range Via Voltage Management
- 17.8 Design for High And Super-High Speed Applications
 - 17.8.1 Electromagnetic Limitations
 - 17.8.2 Rotor Cooling Limitations
 - 17.8.3 Rotor Mechanical Strength
 - 17.8.4 The Solid Iron Rotor
 - 17.8.5 21 Kw, 47,000 Rpm, 94% Efficiency With Laminated Rotor [11]
- 17.9 Sample Design Approach for Wide Constant Power Speed Range
Solution Characterization
- 17.10 Summary
- 17.11 References
- 18 Optimization Design
- 18.1 Introduction
- 18.2 Essential Optimization Design Methods
- 18.3 The Augmented Lagrangian Multiplier Method (ALMM)
- 18.4 Sequential Unconstrained Minimization
- 18.5 A Modified Hooke–Jeeves Method
- 18.6 Genetic Algorithms
 - 18.6.1 Reproduction (evolution and selection)
 - 18.6.2 Crossover
 - 18.6.3 Mutation
 - 18.6.4 GA Performance Indices
- 18.7 Summary
- 18.8 References
- 19 Three Phase Induction Generators
- 19.1 Introduction
- 19.2 Self-Excited Induction Generator (SEIG) Modeling
- 19.3 Steady State Performance of SEIG
- 19.4 The Second Order Slip Equation Model for Steady State
- 19.5 Steady State Characteristics of SEIG for Given Speed And Capacitor
- 19.6 Parameter Sensitivity in SEIG Analysis
- 19.7 Pole Changing Seigs
- 19.8 Unbalanced Steady State Operation Of SEIG
 - 19.8.1 The Delta-Connected SEIG
 - 19.8.2 Star-Connected SEIG
 - 19.8.3. Two Phase Open
- 19.9 Transient Operation Of SEIG
- 19.10 SEIG Transients with Induction Motor Load
- 19.11 Parallel Operation of Seigs

- 19.12 The Doubly-Fed IG Connected to the Grid
 - 19.12.1. Basic Equations
 - 19.12.2 Steady State Operation
- 19.13 Summary
- 19.14 References
- 20 Linear Induction Motors
 - 20.1 Introduction
 - 20.2 Classifications and Basic Topologies
 - 20.3 Primary Windings
 - 20.4 Transverse Edge Effect in Double-Sided LIM
 - 20.5 Transverse Edge Effect in Single-Sided LIM
 - 20.6 A Technical Theory of LIM Longitudinal End Effects
 - 20.7 Longitudinal End-Effect Waves and Consequences
 - 20.8 Secondary Power Factor and Efficiency
 - 20.9 The Optimum Goodness Factor
 - 20.10 Linear Flat Induction Actuators
 - 20.11 Tubular LIAs
 - 20.12 Short-Secondary Double-Sided LIAs
 - 20.13 Linear Induction Motors for Urban Transportation
 - 20.14 Transients and Control of LIMs
 - 20.15 Electromagnetic Induction Launchers
 - 20.16 Summary
 - 20.17 Selected References
- 21 Super-High Frequency Models and Behaviour of IMs
 - 21.1 Introduction
 - 21.2 Three High Frequency Operation Impedances
 - 21.3 The Differential Impedance
 - 21.4 Neutral and Common Mode Impedance Models
 - 21.5 The Super-High Frequency Distributed Equivalent Circuit
 - 21.6 Bearing Currents Caused by PWM Inverters
 - 21.7 Ways to Reduce PWM Inverter Bearing Currents
 - 21.8 Summary
 - 21.9 References
- 22 Testing of Three-Phase IMs
 - 22.1 Loss Segregation Tests
 - 22.1.1 The No-Load Test
 - 22.1.2 Stray Losses From No-Load Overvoltage Test
 - 22.1.3 Stray Load Losses From the Reverse Rotation Test
 - 22.1.4 The Stall Rotor Test
 - 22.1.5 No-Load and Stall Rotor Tests with PWM Converter Supply
 - 22.1.6 Loss Measurement by Calorimetric Methods
 - 22.2 Efficiency Measurements
 - 22.2.1 IEEE Standard 112–1996
 - 22.2.2 IEC Standard 34–2
 - 22.2.3 Efficiency Test Comparisons
 - 22.2.4 The Motor/Generator Slip Efficiency Method

- 22.2.5 The PWM Mixed Frequency Temperature Rise and Efficiency Tests
- 22.3 The Temperature-Rise Test Via Forward Shortcircuit (FSC) Method
- 22.4 Parameter Estimation Tests
 - 22.4.1 Parameter Calculation From No Load And Standstill Tests
 - 22.4.2 The Two Frequency Standstill Test
 - 22.4.3 Parameters From Catalogue Data
 - 22.4.4 Standstill Frequency Response Method
 - 22.4.5 The General Regression Method For Parameters Estimation
 - 22.4.6 Large IM Inertia and Parameters From Direct Starting Acceleration and Deceleration Data
- 22.5 Noise and Vibration Measurements: From No-Load to Load
 - 22.5.1 When on-Load Noise Tests Are Necessary?
 - 22.5.2 How to Measure the Noise On-Load
- 22.6 Summary
- 22.7 References
- 23 Single-Phase Induction Machines: The Basics
 - 23.1 Introduction
 - 23.2 Split-Phase Induction Motors
 - 23.3 Capacitor Induction Motors
 - 23.3.1 Capacitor-Start Induction Motors
 - 23.3.2 The Two-Value Capacitor Induction Motor
 - 23.3.3 Permanent-Split Capacitor Induction Motors
 - 23.3.4 Tapped-Winding Capacitor Induction Motors
 - 23.3.5 Split-Phase Capacitor Induction Motors
 - 23.3.6 Capacitor Three-Phase Induction Motors
 - 23.3.7 Shaded-Pole Induction Motors
 - 23.4 The Nature of Stator-Produced Airgap Field
 - 23.5 The Fundamental M.M.F. and Its Elliptic Wave
 - 23.6 Forward-Backward M.M.F. Waves
 - 23.7 The Symmetrical Components General Model
 - 23.8 The d-q Model
 - 23.9 The d-q Model Of Star Steinmetz Connection
 - 23.10 Summary
 - 23.11 References
- 24 Single-Phase Induction Motors: Steady State
 - 24.1 Introduction
 - 24.2 Steady State Performance with Open Auxiliary Winding
 - 24.3 The Split Phase and The Capacitor IM: Currents And Torque
 - 24.4 Symmetrization Conditions
 - 24.5 Starting Torque and Current Inquiries
 - 24.6 Typical Motor Characteristic
 - 24.7 Non-Orthogonal Stator Windings
 - 24.8 Symmetrisation Conditions for Non-Orthogonal Windings
 - 24.9 M.M.F. Space Harmonic Parasitic Torques

- 24.10 Torque Pulsations
- 24.11 Inter-Bar Rotor Currents
- 24.12 Voltage Harmonics Effects
- 24.13 The Doubly Tapped Winding Capacitor IM
- 24.14 Summary
- 24.15 References
- 25 Single-Phase IM Transients
 - 25.1 Introduction
 - 25.2 The d-q Model Performance in Stator Coordinates
 - 25.3 Starting Transients
 - 25.4 The Multiple Reference Model for Transients
 - 25.5 Including the Space Harmonics
 - 25.6 Summary
 - 25.7 References
- 26 Single-Phase Induction Generators
 - 26.1 Introduction
 - 26.2 Steady State Model and Performance
 - 26.3 The d-q Model For Transients
 - 26.4 Expanding the Operation Range with Power Electronics
 - 26.5 Summary
 - 26.6 References
- 27 Single-Phase IM Design
 - 27.1 Introduction
 - 27.2 Sizing the Stator Magnetic Circuit
 - 27.3 Sizing the Rotor Magnetic Circuit
 - 27.4 Sizing the Stator Windings
 - 27.5 Resistances and Leakage Reactances
 - 27.6 The Magnetization Reactance X_{mm}
 - 27.7 The Starting Torque and Current
 - 27.8 Steady State Performance Around Rated Power
 - 27.9 Guidelines for a Good Design
 - 27.10 Optimization Design Issues
 - 27.11 Summary
 - 27.12 References
- 28 Single-Phase IM Testing
 - 28.1 Introduction
 - 28.2 Loss Segregation the Split Phase and Capacitor Start IMs
 - 28.3 The Case of Closed Rotor Slots
 - 28.4 Loss Segregation the Permanent Capacitor IM
 - 28.5 Speed (slip) Measurements
 - 28.6 Load Testing
 - 28.7 Complete Torque-Speed Curve Measurements
 - 28.8 Summary
 - 28.9 References